

This document provides a written explanation of the methods used to calculate the actual fugitive emissions for 2017 from alkoxylation area components in ethylene oxide or propylene oxide (EO/PO) service at Vantage Specialties, Inc.'s Gurnee Facility. A calculation spreadsheet is also provided.

FUGITIVE EMISSION CALCULATIONS FOR MONITORED COMPONENTS

The actual EO/PO emissions from the alkoxylation area for calendar year 2017 were estimated by the LDAR contractor using U.S. EPA's SOCM I correlation equations whenever concentration data were available from LDAR monitoring. The step-by-step calculations for the monitored components are discussed as follows.

For each component, two monitored concentration values (columns "ppmread1" and "ppmread2") are averaged (column "scrnvalue") for use in the calculations.

Based on a permit condition that Vantage Specialties voluntarily undertook, certain components in the alkoxylation area (in EO/PO service) are monitored according to 40 CFR 63 Subpart H (HON), which specifies different frequencies (i.e., monthly, quarterly, or annually) for different component types. The column "opdays" specifies the number of days between the two monitoring events that have been averaged, and also provides an indication of the HON monitoring frequency. The number of days is then multiplied by 24 hours per day to obtain the number of hours (column "ophours") between monitoring events. The average concentrations are applied for this period of time between two monitoring dates.

The correlation equations are shown in column "cecalc", with the number of operating hours and a unit conversion from kilograms to pounds also shown. The calculated emission rates are shown in column "ce_emiss" for each component. The correlations developed by the U.S. EPA (as discussed in Section 2.3.3 of the U.S. EPA's "Protocol for Equipment Leak Emission Estimates", and summarized in Table 2-9 of that document), which relate screening values (in ppmv) to mass emission rates for SOCM I process units are presented below.¹

Gas valves

$$\text{Leak rate (kg/hr)} = 1.87e^{-6} \times (SV)^{0.873}$$

Light liquid valves

$$\text{Leak rate (kg/hr)} = 6.41e^{-6} \times (SV)^{0.797}$$

Light liquid pumps

$$\text{Leak rate (kg/hr)} = 1.90e^{-5} \times (SV)^{0.824}$$

Connectors

$$\text{Leak rate (kg/hr)} = 3.05e^{-6} \times (SV)^{0.885}$$

Where:

¹ The U.S. EPA document may be found at: <http://www3.epa.gov/ttn/chief/efdocs/equiplks.pdf>

SV = screening values (i.e., average monitored concentration) in ppmv

An example calculation is provided below, incorporating the operating hours and unit conversion.

Example Calculation

As shown in column “cecalc”, emissions were calculated using the following general equation:

$$Leak\ rate\ (lb) = [A \times (SV)^B]^{kg/hr} \times Hours \times 2.204623\ lb/kg$$

Where:

A, B = constants specified in Table 2-9 of the U.S. EPA guidance document and that vary based on component type (gas valves, light liquid valves, light liquid pumps, connectors)

SV = screening values (ppmv)

Hours = obtained from “ophours” column

2.204623 = conversion from kg to lb

Example calculation – VOM Emissions from Gas Valve

Below are parameters for one of the gas valves (tag no. 660) in the 2017 emission calculations, based on monitoring results in January and February 2017:

Monitored concentration 1 (“ppmread1”) = 4.94 ppm

Monitored concentration 2 (“ppmread2”) = 5.37 ppm

Average concentration (“scrnvalue”) = 5.155 ppm

Hours (“ophours”) = 1091.891664 hours

For gas valves, the correlation equation constants are

A = $1.87e^{-6}$

B = 0.873

$$Leak\ rate\ (lb) = [1.87e^{-6} \times (5.155)^{0.873}]^{kg/hr} \times 1091.891664\ hours \times 2.204623\ lb/kg = 0.018842lb$$

The total actual annual EO/PO emission rate from all monitored alkoxylation components is the sum of the individual emissions calculated from each component’s monitoring events throughout the year (i.e., sum of column “ce_emiss”). Vantage then speciated the EO emissions from the PO emissions based on a ratio of 80% ethylene oxide and 20% propylene oxide.